Propofol in Office-Based Plastic Surgery

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ABSTRACT

Propofol is the nearly ideal agent for office-based plastic surgery. Among all anesthetic agents, only propofol has the ability to elicit happiness in this special group of patients. Cosmetic surgery patients will tolerate discomfort in preference to postoperative nausea and vomiting. Propofol is a powerful antiemetic agent. Patient safety will not be optimized unless the person responsible for the administration of propofol has airway management skills. Dedicated anesthesia providers are highly skilled in airway management. Although the short half-life of propofol is seductive for a fast-acting, rapid emerging anesthetic, interindividual differences in propofol response make measurement of the target organ (i.e., the brain) with a bispectral index (BIS) monitor very important. BIS levels < 45 for > 1 hour are associated with increased 1-year anesthesia mortality thought to be associated with an inflammatory response. The only currently available way to avoid overmedicating with propofol is to monitor with a level of consciousness monitor like BIS.

KEYWORDS: Propofol, anesthesia, BIS monitor, office-based plastic surgery, ketamine

Propofol (2,6-diisopropylphenol; Diprivan®) was introduced in the world market in 1986 and in the North American market in 1989. It was marketed as a hypnotic agent to replace thiopental (Pentothal®) and methohexital (Brevital®).

Of the many positive attributes of propofol, the one most relevant to the practice of elective plastic surgery is the production of a positive or happy mood in patients receiving it. This happy state is qualitatively different from the silliness from nitrous oxide or the euphoria from opioids. Patients seeking elective plastic surgery are generally trying to improve their level of happiness. There are no other drugs in the anesthesiologist's armamentarium that predictably produce happiness.

According to The Doctors' Company, a medical liability insurance firm with a high concentration of plastic surgeons, the average anesthesiologist can expect to be sued once every 8 years. This author has not even been named in a malpractice action in the past *14 years* since administering propofol as the primary agent exclusively for office-based, elective plastic surgery. Patients tend not to sue people they like. Patients generally confuse the happiness they experience from their propofol-based anesthetic with positive feelings for the anesthesiologist who has administered it to them.

Another significant attribute of propofol is its antiemetic property. Macario et al conducted a statistically validated survey of a panel of expert anesthesiologists on what postoperative anesthetic outcome *they* believed patients most wanted to avoid.[1] The anesthesiologists concluded that *pain* was the number one anesthesia outcome patients most desired to avoid. A follow-up, similarly statistically validated survey of patients' anesthesia outcomes they most desired to avoid was *emesis!*[2] Clearly, a disconnect exists between what anesthesiologists believe about their patients and

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what the patients actually want most to avoid. A potential explanation could be that patients who consent for elective surgery *expect* to have some postoperative discomfort but do not want their pain to be compounded by emesis.

There is a consensus among postoperative nausea and vomiting (PONV) authorities such as Apfel, Scuderi, Gan, White, and Chung that both inhalational anesthetics and opioids are emetogenic agents. "In the *context* of [emetogenic] anesthesia, postoperative pain management and opioid related PONV remain problems."[3] In the context of emetogenic anesthesia, experts advise "multimodal" prophylaxis in the highest risk group.[4]

Apfel's recent *New England Journal of Medicine* article identifies the highest PONV risk group of patients as nonsmoking females, with a history of previous PONV and/or motion sickness, having emetogenic (i.e., elective cosmetic) surgery of 2 or more hours.[5] Apfel's criterion of high risk apply *exceptionally* well to Friedberg's series of 2683 patients.[6]

The minimally invasive anesthesia (MIA)® technique[7] is propofol ketamine monitored anesthesia care (PKMAC) with the addition of bispectral index (BIS) monitoring. The MIA® technique[7] is not perfect but contextually nonemetogenic. Without *any* antiemetic prophylaxis, Friedberg's high-risk group of patients experienced a total of 13 PONV events for an unprecedented 0.5% PONV rate![6] An ounce of prevention is worth a pound of cure.

Ketamine eliminates the noxious input of the injection of local analgesia while avoiding emetogenic agents like intravenous opioids. Lidocaine provides intraoperative analgesia with bupivacaine (when appropriate) providing postoperative analgesia. In this *context*, it has been extremely rare for patients to require (emetogenic) opioid relief of their postoperative discomfort. Typically, acetaminophen (Tylenol® [McNeil Consumer & Speialty Pharmaceuticals, Fort Washington, PA]) 1000 mg by mouth is adequate for the few patients who request pain relief. Elimination of all emetogenic triggers defines nonopioid, preemptive analgesia (NOPA). NOPA is the hallmark of the MIA® technique. In Friedberg's 14-year experience, no patients have been admitted to the hospital after MIA® technique for either PONV or unmanageable pain.

The antiemetic property of propofol can be overridden by the administration of opioids or narcotics. Opioids are morphine, hydromorphone (Dilaudid® [Abbott Laboratories, Abbott Park, PA]), meperidine (Demerol), fentanyl, alfentanil, sufentanil, and remifentanil.

Agonist-antagonist drugs may similarly negate the antiemetic property of propofol. These drugs include agents like nalbuphine (Nubain® [Endo Pharmaceuticals, Chadds Ford, PA]), butorphanol (Stadol® [Reckitt Benckiser Pharmaceuticals, Inc., Benckiser, VA]), and buprenorphine (Buprenex® [Reckitt Benckiser, Pharmaceuticals, Inc., Beckiser, VA]).

The short half-life of propofol is the property most seductive for the office-based plastic surgery practice. It is in the mutual interest of surgeons, anesthesiologists, and their patients to rapidly emerge from anesthesia to facilitate a timely discharge from the office. Until recently, a limiting factor in the widespread administration of propofol has been the cost. The market force of having a third supplier (Hospira) of generic propofol has caused the price to drop from $10 to $12 per 20-mL bottle to around $3! All preparations of propofol have been shown to be equally safe and effective. The MIA® technique typically uses two 20-mL bottles of propofol per hour.[8] Clonidine premedication has been useful in achieving this rate.[9]

Independent of a patient's use of alcohol or street drugs, there is a 19-fold variation in how propofol is metabolized.[10] The metabolic variability tends to defeat propofol dosing schemes that rely on per body weight basis or the even more sophisticated, targeted controlled infusion (TCI) devices common in Europe.

HOW CAN THE SAFEST POSSIBLE ADMINISTRATION OF PROPOFOL BE ACHIEVED?

> When you can measure what you are speaking about, and express it in numbers, you know something about it; but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meager and unsatisfactory kind; it may be the beginning of knowledge, but you have scarcely, in your thoughts, advanced to the stage of science.
>
> William Thompson, knighted Lord Kelvin.
> Popular lectures and addresses 1891–1894

It is intuitively obvious that measuring the organ one is trying to medicate is superior to clinical guessing. The brain is the target organ of propofol. Propofol is well measured by the BIS algorithm (Table 1 Benzodiazepines, that is, diazepam (Valium® [Hoffman-La Roche, Inc., Nutley, NJ]) and midazolam (Versed® [Hoffman-La Roche, Inc., Nutley, NJ]), are commonly administered for intravenous (IV) sedation in office-based settings. However, benzodiazepines are not measurable by the BIS monitor (Table 1).

The BIS monitor facilitates a numerical expression of the *hypnotic* component (anesthesia = hypnosis + analgesia) of the anesthetic state and may permit a reasonable inference about the analgesic state. *Heart rate, blood pressure, and other clinical signs are notoriously unreliable indicators of anesthetic depth*.[13] BIS provides

Table 1 BIS Levels and Levels of Sedation/ Anesthesia[11]

BIS	Sedation/Anesthesia Level
98–100	Awake
78–85	Minimal sedation (''anxiolysis'')
70–78	Moderate (''conscious'') sedation*
60–70	Deep sedation†
45–60 + systemic analgesia	General anesthesia‡
< 45, > 1 hour	Overanesthetized[12]

*With moderate sedation, *passive* maneuvers like extension and rotation of the head or shoulder pillow may be all that are necessary to maintain the airway.
†With deep sedation, *active* maneuvers, like nasal airway or LMA, may be required to maintain airway patency.

new information about patients that is simply unavailable from any other vital or clinical sign.[14]

BIS, as an index, has no units. The scale is 0 to 100, with 100 representing awake and zero representing isoelectric (or zero) brain activity. Hypnosis compatible with general anesthesia (GA) occurs between BIS 45 and 60. BIS 45 to 60 with *systemic* analgesia defines general anesthesia. BIS 60 to 75 with adequate *local* analgesia is a major part of the MIA® technique. Patients who received MIA® neither hear, nor feel, nor remember their surgical experience.[6]

Monk et al published an associated 20% increase in the 1-year mortality risk *associated* with *every* hour of BIS < 45.[12] Therefore, BIS < 45 for cumulative periods greater than 1 hour must be considered as overmedicating.

The routine practice of overmedicating for fear of undermedicating is no longer a desirable or acceptable practice.

Monk et al postulated that the increase in 1-year anesthetic mortality might be related to an inflammatory response from excessively deep anesthetics.[12] C-reactive protein levels are markers for inflammation. A more recent prospective, randomized controlled study demonstrated increased C-reactive protein levels with BIS < 45 for more than 50% of the cases.[15]

The BIS monitor does not replace traditional vital sign monitoring, that is, electrocardiogram (EKG), noinvasive automated blood pressure (NIABP), pulse oximetry (SpO_2), or end tidal carbon dioxide ($EtCO_2$) when indicated. When measured, the $EtCO_2$ typically runs between 38 and 42 with the MIA® technique. The $EtCO_2$ offers the display of the waveform of the patient's respiration. Many experienced anesthesiologists are capable of assessing adequate respiratory movement without this information. More than 3000 propofol ketamine monitored anesthesia care (PK MAC) cases have been safely anesthetized without $EtCO_2$ monitoring.

Titrating anesthesia with BIS trend is limited by the fact that the processing required for the BIS algorithm is delayed 15 to 30 seconds behind real time. This delay has given rise to the legitimate criticism that BIS does not predict patient movement. BIS, a measure of the hypnotic state, was not designed to predict patient movement. Electromyogram (EMG) is the instantaneous display of the frontalis muscle activity if the Windows XP software version of the BIS A2000 is used.

Table 2 MIA® Airway Algorithm

1. Extend and laterally rotate head (facelift position)
2. Shoulder pillow
3. Nasal airway (no. 28 Fr, lubricated)
4. LMA (no. 4, lubricated)

Inadequate analgesia leading to patient movement is predictable if the EMG is selected from the advanced screen menu to trend as a secondary trace. A spike in EMG (when BIS is 60 to 75, in spontaneously breathing patients) nearly always predicts inadequate analgesia, preceding patient movement. The anesthesiologist should use the 15- to 30-second delay in the change of the BIS value to simultaneously bolus propofol while encouraging the surgeon to supplement the local analgesia.

Measuring the propofol level is less likely to result in levels of sedation deeper than intended. However, if the individual responsible for administering the propofol does not have the ability to rescue from deeper than intended levels of sedation, avoidable tragedy is the likely outcome.

The short half-life of propofol *and* the ability to measure its effect on the individual patient's brain are *not* an adequate assurance of safety if the person administering the propofol does not have airway management skills.

In more than 3000 patients anesthetized with propofol by this author over the past 14 years, none has required endotracheal intubation to adequately manage the patient's airway. All patients have been successfully managed with the algorithm in Table 2. The facelift position, head extended and laterally rotated, produces two vectors of force on the genioglossus muscle. This maneuver often results in a patent airway. The vast majority of patients have been successfully managed with this maneuver or a nasal airway. Fewer than 5% of patients required a laryngeal mask airway (LMA). Approximately 10% of patients required supplemental oxygen to maintain $SpO_2 > 90\%$ (Table 2).

CONCLUSION

The qualities of happiness, antiemesis, and short half-life make propofol the nearly ideal agent for office-based plastic surgery. Airway management skills are absolutely essential. Maximal safety administering propofol will result from *measuring* the level of sedation with the BIS monitor. Overmedicating can produce deeper than intended levels of sedation and has now been shown to be undesirable.[12,15] The BIS monitor

must be considered a standard of care when propofol is being administered.

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